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title: **Effect of land use change on groundwater quality in pumping wells**

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Diffuse contaminant sources such as agriculture are among the main causes of a progressive deterioration of groundwater quality in many countries (Bohlke, 2002). The European Water Framework Directive and national directives (e.g. nitrate projects in Switzerland) prescribe measures to reverse persistent upwards trends in contaminant concentrations. In case of nitrate, probably the most pervasive agricultural contaminant, a common measure consists in converting intensive to extensive agriculture (McMahon et al., 2008).

Assessment of the effectiveness of such projects requires a good understanding of dynamics of contaminant transfer from the land surface where measures are taken to the pumping well. The reaction of pumping wells is influenced by numerous factors such as the temporal evolution of the quality of recharge water, reactive processes within the aquifer and the transit time of contaminants through the vadose and saturated zone (Molenat, Gascuel-Odoux, 2002). This study aims to understand and quantify the effect of these factors on the observed evolution of the groundwater quality in the pumping well supplying the town of Wohlenschwil, Switzerland.

The study area, located near Zurich, Switzerland, consists of an unconfined Quaternary sand and gravel aquifer with a recharge area of around 1 km^2. In the central part of the aquifer, the water table is located around 12 m below the surface. The conversion to extensive agriculture has lead to a rapid decrease of the nitrate concentration in the pumping well from about 50 mg/l in 1997 to around 25 mg/l since 2003 (Fig. 1, 2).

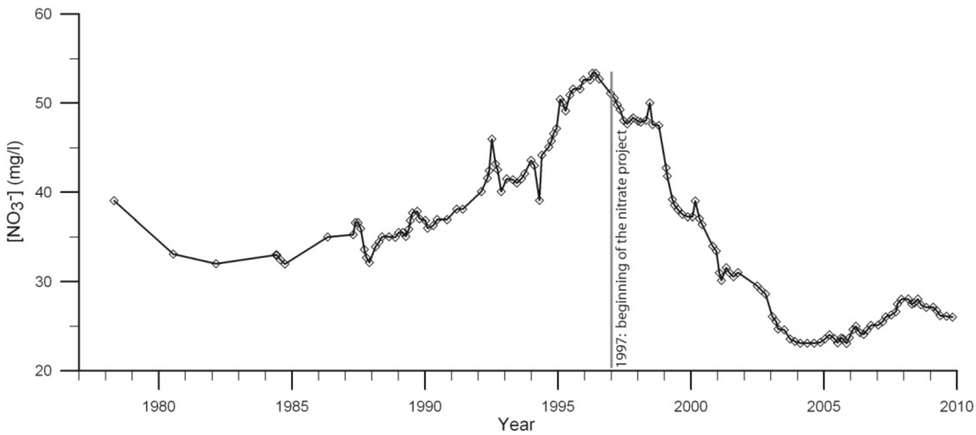

Figure 1. Evolution of concentration of nitrate in the pumping station.

In order to assess the dynamics of contaminant transfer across the vadose and unsaturated zone, a number of different methods were used. The seasonal variability of groundwater recharge was quantified using a soil water balance model based on measured meteorological and water content data. Tracer tests (bromide and chloride) were carried out across the vadose zone at six experimental plots with different land use. Finally, the transit time in the saturated zone was assessed using tracer methods as well (fluorescent dyes). Based on the obtained information and the history of land use which is well known, the response of the system to land use changes was reconstructed and the key factor that control the dynamics of the response identified.

Figure 2. Land use before 1997 (left figure) and after 1997 (right figure). Intensive agriculture area was strongly decreased after 1997 (gray zones).

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